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Usefulness of Alvarado Score for the Diagnosis of Acute Appendicitis in Hospitals of Poor Resources

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ABSTRACT

Background: The delay in diagnosing appendicitis is associated with a significant increase in mortality and morbidity among patients due to complications such as perforation, peritonitis and septicaemia. Therefor, Alvarado score is one of the tools used to diagnose appendicitis and reduce the probability of delayed diagnosis based on clinical and laboratory indicators. **Objective**: This study aimed to evaluate the precision of Alvarado score in diagnosing appendicitis among suspected patients in al-Wihda teaching hospital, Thamar University, Yemen. **Methods**: a total od 106 participants suspected of having appendicitis due to the clinical presentation were included in the study. Alvarado score was determined in each of the participants upon tier arrival to the emergency department of the hospital. Based on the follow up, histological examination and the intra operative observation the diagnosis was confirmed or excluded. The accuracy of the score was evaluated by calculating sensitivity, specificity, positive and negative predictive values and likelihood ratios. **Results**: The cut point of Alvarado score 8 was used in diagnosing appendicitis with 87% and 93% sensitivity and specificity respectively. The positive the likelihood ratio was 12 and the negative likelihood ratio was 0.14. **Conclusion**: Alvarado score is a promising criterion-based tool that would vitally help in early detection of appendicitis among patients. More efforts are required to improve precision of test and minimize the number of cases mistakenly diagnosed with appendicitis in hospitals with limited resources.

KEYWORDS: Appendicitis, appendectomy, Alvarado score, specificity and sensitivity

INTRODUCTION

Appendicitis is the most common abdominal emergency worldwide with approximate numbers of admission in the united states of America staggering at 293,000 in 2010 (1). Appendicitis commonly effects age groups between 10 and 20 years, being more common in male and with those with positive family history of appendicitis (2). The definite treatment of appendicitis is the surgical removal of the appendix or what is known as appendectomy which counted for 327,00 operations in the united states hospitals in 2011 (3). This is because appendicitis can lead to significant number of complications and even cause mortality occasionally in which the global figure of mortality due to appendicitis was approximately 72,000 in 2013 (4). Most of the morbidities and mortality associated with appendicitis are due to delayed diagnosis (5). The diagnosis of this disease in mostly determined by routine history taking, clinical examination and some laboratory investigations; however, it might be difficult to be diagnosed specially in the early stages of the disease. A confirmed diagnosis can only be obtained during the time of surgery and after pathological examination of surgical specimens (6). The Alvarado scoring system developed by Alfred Alvarado in Florida, USA is one of the tools that might help in minimizing this problem (7). This scoring systems was designed to diagnose acute appendicitis and to reduce the negative appendicectomy rates without increasing morbidity and mortality (8). Similarly, this test depends purely on history, clinical examination and few laboratory tests. Each of these features are represented with a score as shown in table 1.

The scoring system is based on three symptoms, three signs and two laboratory findings (Shown in Table 1). Interpretation and the use of the system is as follows: Patients with a score of 1-4 are considered very unlikely to have acute appendicitis and were observed; those patients with a score 5-6 are considered to have a diagnosis compatible with acute appendicitis, but not convincing enough to warrant appendectomy and were regularly reviewed; those with a score of 7-8 were considered to have a probable acute appendicitis, and those with a score of 9-10 were considered to have an almost definite acute appendicitis and were submitted to operation (7). This study aimed to determine the effectiveness of using Alvarado score in diagnosing appendicitis with the intra operative confirmation of the results.

Table I Alvarado score (7)

Variables	Clinical features	Score
Symptoms	Migratory right iliac fossa pain	1
	Anorexia	1
	Nausea and vomiting	1
Signs	Tenderness in the right iliac fossa	2
	Rebound tenderness	1
	Fever	1
Laboratory	Leucocytosis	2
	Shift to the left	1
Total Score		10

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METHODS

This prospective study was ethically approved by the local ethical committee in al-Wihda teaching hospital in Yemen and all the participants signed a consent form before joining the study. The number of patients suspected with acute appendicitis were 106, who were admitted to the emergency department of al-Wihda teaching hospital, Thamar University, Yemen over the period of 12 months. At the time of admission, Alvarado scoring was done for all the patients depending on history taking, clinical examination and white blood cell count. The definite diagnosis of acute appendicitis was confirmed by operative findings with histological examination of the appendicectomy specimens in the histopathological lab.

The Alvarado score cut points were classified into three categories: Group A: (8-10), group B: (5-7) and group C: (0-4). The results were tabulated and analysed by calculating the sensitivity, specificity of the test, positive and negative predictive value and positive and negative likelihood ratios.

RESULTS AND DISCUSSION

All patients were categorized into three groups accordingly as shown in Table II.

56 patients were in group A where all the patients underwent surgery. Three of patients who underwent surgery were found to be free from acute appendicitis. While 17 patients were in group B, and all patients were admitted to the surgical department for observation and rescoring for Alvarado in a regular interval of six hours. Consequently, 8 patients underwent surgery because of either an increase in their Alvarado score or due to worsening of their symptoms. While the remaining 9 patients were either found to have another pathology or their scoring decreased below 4 and they were discharged to be followed up in the out-patient's clinic. In addition, 33 patients were grouped in C who were unlikely to have acute appendicitis and were followed up in the outpatient clinic for one week followed by complete remission of their symptoms.

Table II Alvarado scoring groups

	Patients with appendicitis	Patients without appendicitis	Total
Group A	53	3	56
Group B	8	9	17
Group C	0	33	33
Total	61	45	106

Based on the above results the sensitivity of the Alvarado score was 100% (93.28% to 100.00% C.I.), specificity was 91.67% (77.53% to 98.25% C.I.), positive predictive value was 94.64%, negative predictive value was 100% and the accuracy was 96.65% (90.46% to 99.30% C.I.).

In addition, a modified Alvarado scoring cut point was adapted in this study at the total score of 8. In this modified version, patients were grouped in two groups using the same Alvarado score system where a score between 8 to 10 was in group A and would be regarded as positive and was subjected to surgery; while a score between 1 to 7 was in group B and was considered negative to be monitored accordingly and then discharged from the hospital as described in Table III.

Table III modified Alvarado scoring groups

	Patients with appendicitis	Patients without appendicitis	Total
Group A	53	3	56
Group B	8	42	50
Total	61	45	106

According to the this modified score the prevalence of appendicitis in the selected sample of patients was 57%. Accordingly, sensitivity and specificity were calculated and were found to be 87%, 93% respectively. As shown, this modified cut point of Alvarado score causes a slight improvement of specificity measures with less cases of appendicitis being excluded from operation and being discharged. Such cut point would reduce the morbidity and mortality rates due to the delay in diagnosis (8).

To estimate the precision of diagnosing a patient with appendicitis based on the modified Alvarado score cut point, the positive and negative predicative values where calculated and were found to be 95% and 84% respectively. This demonstrates a slight improvement in the precision in diagnosing patients with appendicitis. Although this means less patients without appendicitis will be excluded and accordingly more patients will be subjected to unnecessary operation with all the associated risks and complications.

The complications of appendicectomy are common, occurring in nearly 20 per cent of patients worldwide including perforation that is the main contributor in morbidity and mortality (9). Other complications include appendiceal abscess, wound infection, hepatic abscess, portal pyelo-thrombophlebitis, pelvic abscess, haemorrhage, long term complications such as ileus, incisional hernia and inflammatory bowel diseases (9, 10). Therefore, a high percentage of false positive cases carries the same morbidity risks to high percentage of false negative cases and both values need to be carefully evaluated to avoid the morbid consequences.

Another issue to be discussed is about the validity of the predictive values; because of the considerable differences of disease prevalence in this sample and the real prevalence of appendicitis in the general population, it is therefore unreliable to depend on the values of the positive and negative predictive values (11). Accordingly, as expected if the prevalence of appendicitis is higher in our selected population sample in comparison with the referenced population this will cause an increase in the positive predicative value and a decrease in the negative predictive value of the test. Which means the test would be able to have a lower precision in diagnosing patients in the general population with more precision in excluding appendicitis free individuals.

Therefore, another statistical measure was used to assess Alvarado score which is known as the likelihood ratio. This ratio combines both sensitivity and specificity in one measure that can

be used in conjunction with the prevalence of appendicitis to estimate the patient's probability of having the disease (12). Consequently, in this modified Alvarado score system, the likelihood ratio for a positive Alvarado score test was found to be 12 which means the patient with appendicitis is about 12 times more likely to be diagnosed with appendicitis than being considered normal. While the likelihood ratio for a negative Alvarado score test was found to be 0.14 which means patients without appendicitis are about seven times more likely to be correctly rolled out from appendicitis diagnosis than having a wrong diagnosis which may limit the associated risks of anaesthesia and the intra and post-operative complications.

CONCLUSION

Alvarado score is a very useful and practical test for diagnosis of appendicitis that has significantly high precision in diagnosing patients. Such a score can therefore minimize the risks of delayed diagnosis. However, more efforts are required to improve the scores ability in excluding non-appendicitis cases and therefore protect the patients from the morbidity and mortality related to the surgical operations.

CONFLICT OF INTEREST

The authors declare no conflict of interest

REFERENCES

1. Barrett ML, Hines AL, Andrews RM. Trends in rates of perforated appendix, 2001–2010: statistical brief# 159. 2013.
2. Omari AH, Khammash MR, Qasaimeh GR, Shammari AK, Yaseen MKB, Hammori SK. Acute appendicitis in the elderly: risk factors for perforation. World J Emerg Surg. 2014;9(1):6.
3. Weiss A, Elixhauser A, Andrews R. Characteristics of operating room procedures in US hospitals, 2011: statistical brief# 170. 2014.
4. Abubakar I, Tillmann T, Banerjee A. Global, regional, and national age-sex specific all-cause and cause-specific mortality for 240 causes of death, 1990-2013: a systematic analysis for the Global Burden of Disease Study 2013. Lancet. 2015;385(9963):117-71.
5. Allemann P, Probst H, Demartines N, Schäfer M. Prevention of infectious complications after laparoscopic appendectomy for complicated acute appendicitis—the role of routine abdominal drainage. Langenbeck's archives of surgery. 2011;396(1):63-8.
6. Dado G, Anania G, Baccarani U, Marcotti E, Donini A, Risaliti A, et al. Application of a clinical score for the diagnosis of acute appendicitis in childhood: a retrospective analysis of 197 patients. J Pediatr Surg. 2000;35(9):1320-2.
7. Alvarado A. A practical score for the early diagnosis of acute appendicitis. Ann Emergency Med. 1986;15(5):557-64.
8. Kalan M, Talbot D, Cunliffe W, Rich A. Evaluation of the modified Alvarado score in the diagnosis of acute appendicitis: a prospective study. Ann R Coll Surg Engl. 1994;76(6):418.
9. Cooperman M. Complications of appendectomy. Surg Clin North Am. 1983;63 (6):1233-47.
10. Rasmussen T, Fonnes S, Rosenberg J. Long-Term Complications of Appendectomy: A Systematic Review. Scand J Surg. 2018:1457496918772379.
11. Mercaldo ND, Lau KF, Zhou XH. Confidence intervals for predictive values with an emphasis to case–control studies. Stat Med. 2007;26(10):2170-83.
12. Brenner H, Gefeller O. Variation of sensitivity, specificity, likelihood ratios and predictive values with disease prevalence. Stat Med. 1997;16(9):981-91.